

Interview to **Peter Kirstein UK.**

During the reception of his Postel Award in Vienna (Austria) 2003.

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Austria.

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kirstein, postel award, Vienna 2003

01: I think Jon had a German background, but he said he called himself Postel ..

... bring the ARPAnet to Europe?

Yes, i mean basically i was interested in it from about 1970 on, but it was clearly likely to go to the national physical department and that was fine, because Donald Davis was doing one of the first works on packet switching at that stage. (How was the dns story) well the dns story was much much later. and the DNS story was more than 10 years later. what happened was that (how did it function before) well, first of all, when the ARPAnet was first of all thought out one had, the amount of memory one had was very very small, when i had my first large computers in Britain, we had 8000 words of memory in a sort of medium size machine. When i was first at CERN there were 8000 words of memory in a very large machine for CERN. So one actually cared about how many bits you had in a word and how many bits you used for addresses. So one when first designed the communications computers for the ARPAnet one took an 8bit address. And of that 8 bits 6 bits was for the node and 2 bits were for the computer. So you could have at most 64 nodes, and 4 computers per node. So the system could not be more than 256 in all computers. And there wasn't much you had to do about 256, you just had a flat file which held the node addresses of all of them and you had a direct mapping of those up to 64 to a number. And there was no real difficulty to doing that. Than

(What stresses me, secure communication system, so how can they consider not having more than 256 computers?) Well, there were several things about it. darpa, or at that stage i think it was called arpa, the advanced research project agency, was a research agency. and the idea was that they were investigating the technology. If one was going to build a military system out of it than there were various other things that you would do to make a military system. Do give an example. We had communications computers called imps. And these were normal computers. Even in the early days there was involvement from some of the military establishments like "ford brake" which were the green perils were - the rangers actually had their headquarters. when they had the same sorts of computers they would sometimes put these in a militarized box and drop them from quite a height so there was always quite a face between the things first being developed in a research environment and what would happen in a military environment (normal computer at this time what was it?) a normal computer was in fact, the computer it was, was a Honeywell 516 normal computer and it was a 19inch rag and it was 6feet high. The big change came in 1976, when the 516 was replaced by the 316 and that was about a quarter of the size and that made a huge difference in the size of it. And than by the time it has got to the late 70s there was perhaps 40 or 50 of those computers and you realized you going to run out of memory very quickly. In the meantime Vint Cerf and bob Kahn who were working at that stage at darpa, had worked out that one wanted to have a connection of networks. And that's when the idea of an internet came. and the main reason for it was because everything we did there was one particular company, bolt beranek and Newman (bbn) who said we couldn't do it for the next 6 month or next year, because they were too busy on something else as part of this project so one had the idea that if you put in a gateway between networks than it wouldn't be so dependent on that particular company. Of course in the end the company produced the gateways as well, so it didn't help. (You had to wait?) No because it was a different part of the company. so that wasn't so bad and besides other people

started producing the gateway, and that made it possible to have a much broader set of these communication computers and at the same time as soon as you started having the idea of a network of networks, of internetwork bob and Vint also thought about having a 32 bit word length for the address. So were before you could have at most 256 you went up to 4 billion. That made a huge difference. You had much much more choice. And at that stage you could' n possible consider doing it by just a file. And so that's when one had a very good idea - i think it was Paul Mockapetris who thought about it at that stage - of having a logical division of the name. And than to have a connection between the name and the actual address. As so often happened there was one way of doing it in the us and another way of doing it in Britain. So the us way of doing it was the domain name system. The British way of doing it was the network registration scheme. and by the time i was running the service - we now got to the early 80s , late 70s early 80s, one of the things i had to do was to translate every day the complete file between the British scheme and the American scheme to keep them up to date. Because, when they talked to the British they had to talk in the British way, when they talked to the Americans they had to talk in the American way and than do the translation in between.

02: What happened with the Swiss and Italian? Well, what happened? What really happened was that the Germans and the Italians and the Norwegians participated in the specific set of research activity, but they never really participated in the attempt to get the service as a long term service. And so they never were deeply involved. i have had joined relations with darpa from 1973 even still now, so i still have some darpa contracts none of the others did that at all. They were just part of that particular research activity that stopped in 1980 or so. We took that particular network technology and actually ran it as a service for other 5 years before it was obsolete. And so we did this for a longer term bases and that is really what they were referring too of “a long term activity” in this. (Going back to the

translation you were talking before) there is always been national in anything technical. And when one country or one project, one country developed the scheme the temptation is for the people who do it next to say: the first people did it wrong we do it properly. And in the case of the domain name service well the British had another method, but even when they decided to have something like the domain name service they decided that the American had it wrong. so were America or the us would have computer science, cs, dot ucl for the university college London, dot edu for the educational research establishment, for all education, the British decided to do it the other way round. u, for the country. dot ac for academic - the decided to use a different two letters than the Americans of course - dot ucl dot cs, because that was the logical way to do it. i tried to tell them please don't do that because I would have to translate them backwards and forwards but that was one of the things I had to do for the next 7 or 8,9 years. And that survived until Czechoslovakia joined the internet. Because what I was doing was I was looking at each of these addresses, guessing - not of course personally but by a program - guessing was probably the right way and either turning them round or not. because sometimes when I went form the real address, sometimes somebody must have written in the message the address to use is so and so and so they would actually already reversed it, so I had to guess and everything worked until Czechoslovakia joined. The tragedy about Czechoslovakia joining is the country code for Czechoslovakia is cs. computer science is cs. and by the time you had cs as the country code there was no way of guessing. And that backward/forward thing collapsed. Probably 1988 or something like that, I donut remember exactly. But the other thing which was happening is that the British had a whole set of protocols which were different from the Americans. and we had to translate the whole of the set from one to the other in such a way that the other one would think: the American would think these computers were direct on the ARPAnet and the British computers would think that the whole of the ARPAnet was part of just on their network and that had to be transparent to

the two (there was also a quarrel of osi - TCP/IP?) yes, well what happened was the Europeans decided that the IP protocol was not very good, partly because it was connection less and so they claimed one couldn't guarantee the service. The European ones were more dominated by the ptt's. by the telephone authorities and they had a different mechanism, they developed x25 and then they developed a whole set of things above them. The British carried that to a logical conclusion and they kept their protocols sweet up to about 1991. One of the reasons I was popular with the British doing what I did was I could keep the Americans sweets at the boundary, so it never had to go inside the country. By contrast in Germany the -probably for political reasons - there was less difficulty in having the us protocols actually go into the ue. Into the whole computers with those networks. Being deployed around Germany, because there was a much more of a pro us activity feeling in Germany in the 70s and 80s, there was a little more hesitation in Britain I would say, or more confidence that they were doing it right. Germany was certainly lacking confidence in those days about doing things correctly in some of these areas. I know some has to be careful with political statements like that.

03 Lack of confidence in Europe?

Of course there is, there is no question about that, I was justifiably of course. But on the other hand, that is one of the things I tried to say in my talk, in spite of that there was a gain, a neutral gain from international activity. Because they would perhaps not quite the same perspective if you are looking at things only from the us side. And that is why I had quite a robustness constructive dialog with Jon Postel over many years on some of these areas and everybody from Steve Crocker who gave the talk today. I worked with Steve from about 1970 onwards, he again it is a club of people who always worked together for long periods.

What I was wondering about IPv6, I have to ask: there are several layers and OSI always was somewhere?

OSI is the open standards, it was the - I think open standard initiative - it was a particular set of protocols which came from ISO, the international standards organization and the lower parts of it came from the CCITT, the international telecommunications union portion of it, the upper ones came from the standards organization. And it was a very logical set of things, which deliberately had a complete separation at each level. The result of it it's been because rather inefficient and never took hold. And in fact became very very clear, but only after a long time that things will go faster and be more efficient if done in the internet style. But for a long time and I was at one stage ordered to stop working on internet protocols in the late seventies, but just happened to think that was the wrong thing to do and so I kept going on them. While also supporting the European standards. Because you cannot work in Europe without at least taking a strong informed view on what the European standards were trying to do.

You stopped working?

No, I was ordered to stop working. On the internet protocols in the late seventies. and I just said no: I said my relations with both defense activities in Britain and DARPA in the US were too valuable to me it was up to the research council whether they funded it, but they were not allowed to tell an academic to stop working., I refused point blank.

So you worked for two military organizations?

No, I think you must distinguish between, well military and working for military organizations and having research activities, which were partially funded by military organizations. And in fact that is one of the places where for very good reasons the links in the German speaking countries between academia and defense are very very different than say in Britain. Although of course there is controversy too, I was always perfectly happy to have

contracts with darpa or mdi on one condition: I always insisted throughout the cold war on having Russian or Chinese or other people like that working in my research group. and if that is going to be acceptable there was no reason what so ever why I couldn't also have research projects funded by the ministry of defense or darpa I would have refused and did refuse to have any censorship either on the publication of results in anything I did or on people. And I mean there were times when I had Iranian working in my research group and I wanted to put one of them on the ministry of defense grant, they said: oh please no donut put an Iranian on; we will have so much explaining to have to do. So I didn't actually put him on that particular grant, but would never have hesitated having them in the research group. And I mean I spend 6 month, 7 month in Russia in the early 60s and often had Russians in my research group and no problem. I have been asked the same question very recently because I am now responsible for a NATO project of putting - it is form the NATO science program - of putting in internet access to the southern Caucasus in central Asia.

And yes I even had people in Britain say how can you do this with military organizations at the time was the beginning of the irk war. To which my answer was well first of all that as far as I was concerned if there is anything which we should be doing it is stabilizing these countries and that is what all this is about. So no hesitation as long as it's that part of NATO perfectly respectable thing of doing for academics.

The thing what they are doing having war is a part of stabilization, is it that what you are saying?

No. I didn't say that at all. I said internet access. That is very important. ? I want to have it clear? The part of NATO which is we are doing that is a science program and is part of the stabilization part of NATO, which is quite separately from the military and quite separately from the political. This is been a program which they have been doing for a long time and by the way one were the Germans had a lot of funding in the same area from the early

90s onwards. Very important area for really stabilizing the governments and trying to make the governments more democratic and change. And yes I think it is a very worthwhile activity and in fact it is an activity where not only is it a NATO science program but I have a European commission project or manage that project. And I think that is the first time that the European commission has ever funded the management of something even vaguely associated with NATO. Even if it's the NATO science program.

04 What did you expect what drove you do go into this area?

First my background has been international for a very long period. I got my undergraduate in Britain, my graduated in the us, which in the 50s was not quite so common, that I worked for a while at CERN in Geneva and while there spend 6 month in Russia, which again wasn't quite so common in the early 60s. Than I worked for an us company but living in Zurich for 4 years and only than went back to Britain. And I stayed consulting with the American company as well, so I was transatlantic for a long period and that what's put me in a good position to be part of this sort of transatlantic activity

You lived the kind of network feeling before you did it?

Oh yes I liked it very much. And when I was working for the us general electric I was responsible for looking at what would happen scientifically in Europe. So yes I have, always had a European and North American interested assisting from a British interest in the things I was doing. And that made a big different, because it meant I had to speak languages to a certain extend which has an impact also on how you get on with the people in the different countries.

How was it to watch the European in what they did?

well it could be very frustrating, it could be frustrating to watch the British being rather slow, it could be frustrating do see how difficult it was to do things in Europe and how much nationalism there was on many of these

things, but as long as far one is recently patient about it eventually things change. And that is actually quite pleasurable to think that you have small impact on the change.

Do you have a clue why the things happened in the states?

Also in the software area: oh I think partially it is a fact - it is partially the whole size of the economy. It is certainly makes a big difference in this area the existence of something like arpa. And remember the reason why darpa existed, the reason - I say arpa and darpa because you may or may not know: arpa stood for advanced research project agency, darpa was its name some times as defense advanced research project agency, sometimes people said it just advanced research project agency and its name went backwards and forwards several times. the reason it was set up was in 1957 when sputnik went up the Americans did not expect sputnik at all and they determined that they would never be caught again so unaware and so they set up that research organization, which was not concerned in much of its activities with direct weapons activity although they also were responsible for much proper related activities, but part of their activities was basic science of one sort or another. We never had equivalent activities at all in Europe. another area which been very very important is that the us has deliberately encouraged large part of its federal activity to be advanced research and development and has encouraged its industry tax wise to do advanced research and development. The European on the whole didn't do things quite that way. That made a difference. On the other hand the Europeans have since 1985 had these collaborative activities between universities and industry. And I have had people from darpa come and visit my group and been absolutely amazed by the close collaboration we have with industry, that does not happen so easily in the us. The European commission had a positive impact on this. it is not necessarily huge advanced RNT that one does in the collaborative projects but at least it is meant that the knowledge and the trust between university and industry on a European wide bases is

quite high now. And the difficulty about the comparison is in one case it is a country and in the other case it is a continent. And it is much easier to do things in a country than it is in a continent.

Positive impact positive you ?

It has an interesting impact - because of the way in which the funding is done, you try to make sure that each project has a geographical distribution. You also try to make sure there is a reasonable amount of industry and reasonable amount of university in this. This is known in the European information society technology programs. One result of it is it is much more tempting to have a British academic work with a European industry outside Britain than inside Britain. Because if you have a sizeable British industrial and sizeable British university that maybe too much of a British component in a European project. So one result of that is to do what the European commission would really like to see happen: break down the national boundaries as far as some of that collaboration and it does that very effectively.

05: Mobile area.fr vs. UK? I think there has - certainly since the early 80s when Margaret Thatcher took over in Britain - there has been a fundamental difference between the way Britain and France has wanted to plan things like research and development. France does have a lot of central planning, government led and has forced through many industrial mergers of one sort or another and will have a central way in which research and development is really controlled. In Britain there is a certain amount of encouragement and a certain amount of funding for that between industry and academia but on the whole the direction is lead from industry. Industry says what they would like to do and that has a very strong influence on the department of trade and industry who do not wish to force industry to go into a certain direction. And one of the places where this is clearest is in IPv6, where there is a positive movement government backed to go in for IPv6 by France. And they have

had a quite strong influence on the European commission. Pushing in the same direction. By contrast I have had the same discussions in Britain and there our relevant ministries are waiting for the leadership to come from British industry. But British industry for several reasons would not necessarily make that, because where as there might be a defense industry certainly, transport one which is government let in policy in France in Britain we have a matter of policy even our defense research agency is a private agency. Now our communication for the ministry of defense, the strategic communications is provided under contract by industry and our health service is no longer a government activity but a private agency. So they would not push for any particular way of doing things, they would leave it to their suppliers. And so there is rather a vacuum at a place where there might be strong central decision making in France. Germany is a bit half way in between.

IPv6, one thing was: running out of addresses?

well actually and of course one of the reason why the us is less concern, because they have plenty of addresses, Europeans are not that short of addresses either yet, the question is because the many tricks one put together. It is the year 2006 or 2010 or 2020 that you are out of addresses is not quite clear. it would have been much faster if there hadn't been the set back in the umts from the license fees, for which Britain can take the credit or blame for having introduced such expensive licenses, there isn't quite as much of a hurry. It is clear they are going to run out, but is still not clear exactly which year. In the Far East it is very different: china couldn't possible the growth it is considering without IPv6. Japan as a matter of policy also has gone in very quickly for it. And that is one of the things that made a huge difference: while the us industry slowly was getting ready to adopt IPv6 they were in no hurry. Cisco was departing from beating for a large NTT Japanese request for proposal because they hadn't the IPv6 in there product at the time. That made them change very quickly and now you find almost all the us manufacturers have very good IPv6 stacks. So they would be ready as

soon as the market was ready for it. on the other hand the internet industry so well developed there and it will be significantly expensive for them to move over to IPv6 so that the customers inform the ISP's are not quite in such a hurry than.

06 What will it mean to move to IPv6?

well, you would've to do a certain amount of re-equipping you going to have to resolve many of the questions which we are discussing here still on the technical side, it will have an expense for a while; one of the reason it would have an expense is because it is clear you going to have to have both lasting for quite a while. And on the whole companies like to avoid having any expense. Sooner or later it will become much more expensive to keep both going or to try to stay with IPv4 alone. exactly when that is, that is very hard to say, I have to think it will be in the early rather than later that is why we are doing a lot of work with IP6 ourselves

What will it change in the network?.

I think the main - IP6, the first thing to think about is the address space. Well if you actually look at the reasoned announcement from the us department of defense they said the one thing they don't care about so much is the address space. Probably they can get a fair amount of it if they want it. They care about the fact that there are many things in IP6 which has thought through things which were done partially wrong with IP4. Most of those things are once that you can do with IP4 but they are adding once later. Things like the use of IPSec for security, a mobile IP, certain parts of auto configuration, they have a lot of use of nets, which is network address translation in order to make IP addresses last longer. Those things and some of the quality of service

Are bits in the headers?

have been thought through again in IPv6, have been made simpler and cleaner and once you get to an all IPv6 network it will be both more efficient and you will be able to count on certain features existing which you can't count on existing in IPv4 network. They probably exist or they will exist partly but they exist in different ways. Eventually they will exist in a standard way in IPv6 networks. And once you can rely on them existing that will have a big difference on the applications and on the way they can be used.

Example?

Yes, at the moment you can't necessarily assume that any particular application or the networks will support multicast, will support mobile IP, those are parts of the IPv6 standard. And so you should be able to rely on them. There are certain problems because there are still places where the mobile telephone industry hasn't completely decided which of the features they will accept themselves and that will take a little time to rationalize yet.

enum, telcos are not interested?

well there is a general concern that voice over IP may be cheaper to produce it may allow quite different competitors in, the whole point about the telecommunications industry used to be that the cost of entry was so high that you had more difficulty in getting new start-ups coming in. even now you find local line access is almost entirely run by what used to be the established carriers. by several of the new access technologies in particular wireless and wireless lans it becomes possible to widen the access to the internet by parsing the carriers to some extent. if that is then combined with voice over IP then you have a very very real competition to the established carriers, which of course they find rather worrying.

You watched the carriers for a long time to you see a change in their behavior?

oh hugely, absolutely hugely. again that started with the British, because they were the first one to be privatized back in 1984 .the French as you know French telecom isn't still in the process of being privatized hasn't quite got there yet. so but, even when they haven't completely got there yet they still feel the competition quite strongly, and the mobile carriers they have given them very very severe competition as well. so they have had to adjust to that competition already. then the existence of things like adsl and others have also making a very big difference and the European commission has quite a few regulations in this area but they have hesitated to take on the carriers completely because the governments of course have always been behind the carriers to some extent in the different countries again you can't generalize it depends on the country.

History: DNS is in place 83 -something like that - is it still the same or changed?

no it has changed a lot. when one thinks that back in those days people like me would just decide what one does. I actually ran .UK for I don't know, while actually I run it until 1997 but that was not from a policy point of view, from about 1993, 92, 93, when the internet took off you suddenly it was discovered how much of a source of money this was. and suddenly things have changed tremendously so there is this huge organizations around how one sets up domain names and who is responsible for them and who can charge whom how much for them. and you saw even with the small part of it which we were seeing here in iana how much activity there was in the session we just heard and then there is a very large activity on trying to decide who is allowed to be responsible high level domains, can sell them to other people and so on.

From the technical point of view?

oh from the technical point of view: there was a thought and that was when I talked a little bit about by Jon Postel that you could have actually have top level domains which were countries and after that everybody was

independent and so it was perfectly all right for the British to decide that they had .co for commercial and dot mgng for "majetive`s government" and dot ac for academic and that could be quite different from what say the us. would do. and the idea was that this perfect nationalism would work. and would make it a very very simple system, but as it happened in all of that type of thinking it hasn't worked, just to give a very simple example, which I gave, Nato cant come under a country, the European commission won't come under a country. a multinational company does not want to be under a single country, it is no point to having 10 different Hewlett Packard or say hundred different Hewlett Packard's, they actually have a global network which wants to be treated as a global network with connections in each of the countries concerned. that doesn't fit into the 1983,4, 5 concept of a national based domain name system service. but you still have Hewlett Packard's. UK. it? you don't know what you have and I gave that example with the BBC. you have bbc.co.uk and when they are actually saying and if you want more about the news - to a British audience that is what they say, but if they do are doing something in the world service they talk about bbc.com, because it depends

07. Still there are 13 root server: have there been 13 at the beginning?

no I haven't followed as how they have grow and when they have grown that way, but they grew more as required. partly for security, partially because you had to have geographic distribution no the system has become very very much more secure over time , very much more replicated over time and when you think about the fact that when I was first involved in this, everybody who was involved with the ARPAnet/Internet would fit around a dinning room table and did. now, it is whatever 500million, 800milllion how ever many it is and of course you need a completely different system to deal with that. and it now has gone into every walk of life completely so there is

no comparison of course the infrastructure needs to support it is completely different.

First email one send to the UK. have you been involved in this yes?

well, what actually happened was there were us mail protocols you mentioned the osi protocols and obviously the British ones were called colored book. and among the early ones was the green book for terminal protocols and the blue book for file transfer and the orange book for transport - I think that is right - and so the transport was the equivalent to TCP/IP and the file transfer was something we called network independent file transfer protocol the equivalent of the arpa ftp, file transfer protocol, and I think the terminal one was triple x, I forgot what it stood for, but it was the equivalent of the terminal or telnet protocol, and of course there was a mail protocol called smtp, simple mail transfer protocol. so of course my group got involved with the specification of the grey book for the British mail transfer protocol. however because we were also involved in running of the mail services we want to make quite sure over both x25 and over the arpa protocols. and I was sure my group was not alone, I can't remember who was involved one of my people Steve kill was heavenly involved but there must have been others as well. and of course the mail protocols were among the most popular. but you must remember that those mail protocols were different from what was in the Unix protocols, there was a uucp one and it was different was what in the ibm protocols and different what was in the decnet protocols, so there was a far amount already of differences, but there were ways of one talking to another. and I think the first time I realized, and any of us realized, quite how well connected the internet came, happened somewhere around 84, 85. through the services I ran we had to do access control and noted anybody going through, the sort of thing we just been hearing about now. and we kept such a list and I think I put access control in one way and not the other and I had a small committee which included British post office, British telecom who than said well you must access control

in both ways. so I had a kept an automatic list of who ever send things through us and I just appended that sent to that a note saying in four weeks time we will block traffic unless you have registered, because we believed some people haven't properly registered. I got a hate mail from about 2 to 5000 people, I have forgotten how many, who said what you have got to do with my mail system. I have been sending messages for the last 6 month or a year and I don't know anything about you. turned out that things were so interconnected that they were going by - nobody in had the slightest idea what roots things were taking at that stage and it was only when you started blocking certain roots that you even noted what was happening.

Do I have to think it literally the grey book, the orange book, ...?

yes they were literally different protocols and you actually had to make sure that all of that protocols were working in the computer which ran them. just as you had to make sure that they were working in any other computer and now of the big things which darpa did was they financed Berkley to have all these protocols running in the Unix Berkley standard release and that was funded by darpa. ones those were running in all the Dec machines there was no choice but for companies like IBM and others to start to running those as well, because otherwise we wouldn't have bought there machines.

When did it get unified? I donut know. there are still separate networks being run by NASA, by the department of energy, etc. the now all run the same protocols, but that's because something like decnet has ended, but there was a while that all the NASA systems run decnet. I think as late as 91, 92 ibm was running the bitnet/earn system of protocols which were quite different from the internet protocols. slowly they started unifying , but sometimes with great reluctance partly because there were commercial reasons not to do it.

08: Now there isn't the slightest question that those protocols have won them all?

most of those advances have actually happened the last period 1990 to 95,96,97. and the biggest single advance there - was of course the worldwide web. and that was really started just because these protocols all looked too complicated. and that's when Berners lee at CERN decided he would try to have a simpler one for some of these things and it turned out he made a number of right choices and so many people now think the web and the internet is the same thing. the fact it is quite it doesn't matter many people think it is and they'd very very surprised when they hear that we had the ARPAnet 30 years ago. they thought it happened in the last 5 or ten years.

Austria got connected late 80s - Austria was actually part of those things much earlier. Graz was actually part of a satellite project being run with CERN and other laboratory somewhere 83, 84, but it was not connected in to the main internet activity, again because I think Austrian telecom didn't quite like the idea at the time?

I had more to do with the Graz people at the time so I didn't know the Vienna people so I was involved with the Graz people on several things but not so much of that activity. I actually avoided internet services on the whole from the middle 80s onwards. it was becoming just too political and too little technical. .. there are different forms of political. a political in which you are trying to do something for a country or a whole part of things is one thing. a political was you are having some infighting on the personality bases is another. I try to avoid that and I am trying to avoid situations for long were there is strong vested interest in running the services. that is not mine. well strong vested interest in running the services. so I have never been concerned with running computer services in my university. let alone - well I was responsible for those in my department I suppose but never in my university and never part of national network services. I had a project to run

international ones but that was different for being responsible for national ones. Licklider: intergalactic connection? I wouldn't have thought that was Licklider, certainly Vint Cerf has a project in interplanetary internet. and it is a genuine one, he is a distinguished - I think his official title is distinguished scientist to Caltech? specifically on the development of interplanetary internet